Quarterly Status Report

NASA Contract R-06-006-037

June 1 - October 31, 1965

Real-Time Height Profiles of Electron Density and Wind Velocity from Ionospheric Radio Soundings

This project supports studies leading to the development of a system for obtaining electron density profiles and wind velocity profiles in real time, by an extension of the well known sweep frequency ionosonde and "spaced receiver" techniques. During the study program, emphasis is on the determination of a practical system design and on the refinement of data analysis methods suitable for real-time use.

System development has been broken down initially into three principal tasks:

1. Radio frequency, group delay, phase path, and echo amplitude
2. Digital computer control of system operation and display.
3. Real-time data analysis by digital computer.

For reasonable economy and directness in system development, these three tasks are planned to be accomplished in series, rather than in parallel. Each task includes a number of sub-tasks representing distinct accomplishments along the way. Much of the potential of the final system, for example, can be demonstrated without waiting for an on-line real-time data processing computer. Starting from the recently designed Model D ionosonde, the attached block diagrams (respectively Figures 1 and 2) illustrate block diagrams recently developed which apply respectively to tasks 1 and 2. Since acceptance and performance tests on the Model D ionosonde are now under way, it is proposed to conduct some experiments with the NASA Granger Model 1902 step-frequency ionosonde leading to digitization of echo amplitude and phase data for wind analysis on six to ten frequencies. As a first step, the ionosonde is to be modified for operation in the 2 - 32 megacylce frequency range.

A correlation method of wind analysis has been tested by comparison with luminous rocket trail wind profiles at Wallops Island, Barbados, and Eglin Air Force Base. Highly satisfactory agreement of the radio and rocket trail techniques has been found for the case where the ionospheric reflector is sporadic E. Unfortunately, the available rocket trail data are so far limited to this case. However, a curious reinterpretation of the radio drift technique seems to be required by these comparisons: It has long been assumed that the uniform drift velocity determined by the spaced receiver technique is twice that of the reflecting region in the ionosphere. Our results show the two velocities to be equal. Since it does not appear likely that the ionized and

neutral movements in the ionosphere can differ by exactly a factor of two, it seems that the diffraction theory underlying the spaced receiver analysis will require modification. A paper on this topic was presented at the Fall meeting of the USA National Committee of URSI, at Dartmouth College, Hanover, New Hampshire, October 5, 1965.

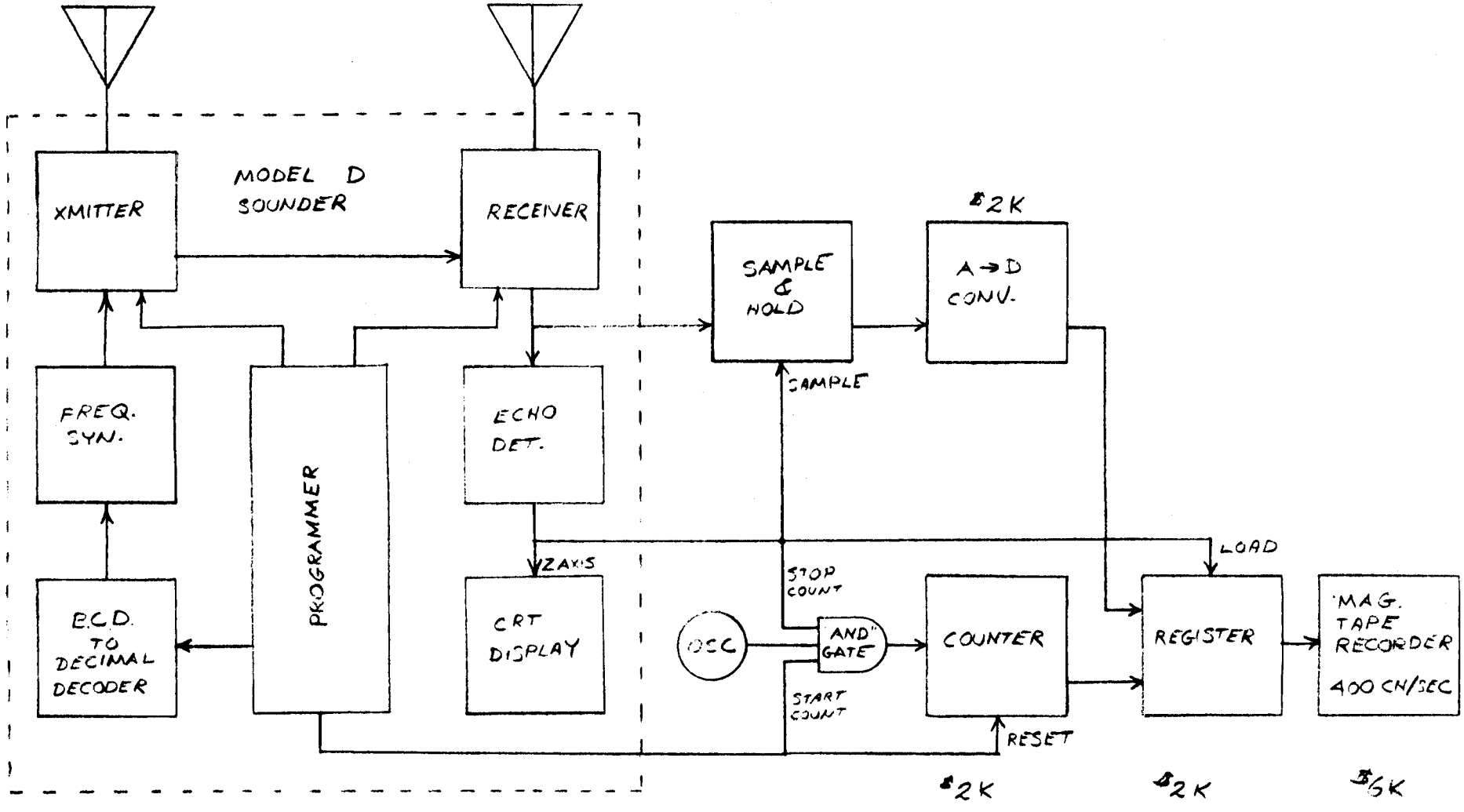

fig. 1. PHASE ONE SYSTEM.

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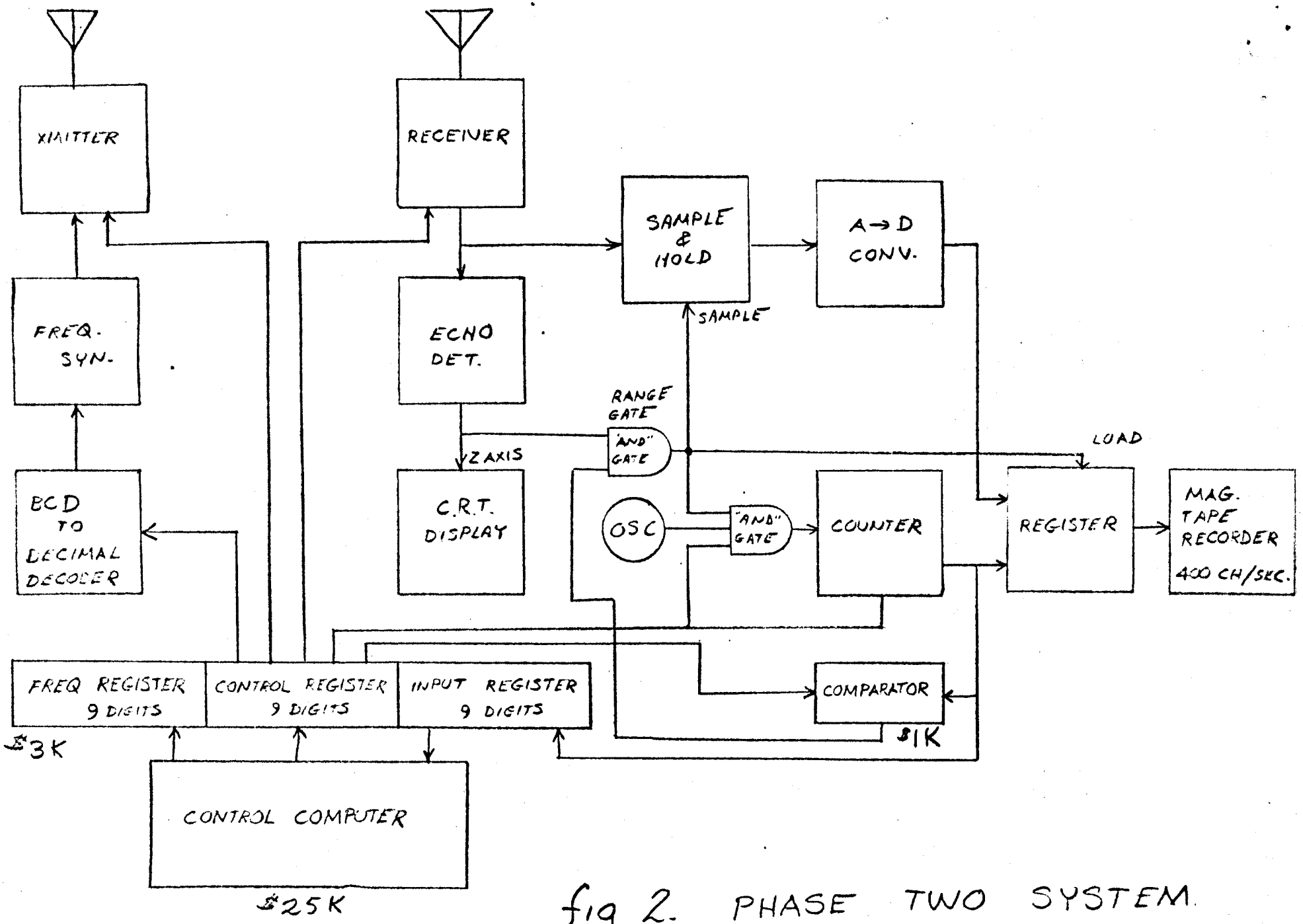

fig 2. PHASE TWO SYSTEM.

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